Centre Number	Examination Number

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Physics

5054/2

Paper 2

2020

Additional Materials:

Graph paper
Electronic calculator (non-programmable)
Answer Booklet

Time: 2 hours **Marks: 80**

Instructions to Candidates

1 Write the **centre number** and your **examination number** on every page of this question paper and on the separate Answer Booklet/Paper provided.

2 There are two sections in this paper

(i) Section A
Answer all questions.
Write your answers in the spaces provided on the question paper.

(ii) Section B
Answer any three questions.
Write your answers in the separate Answer Booklet provided.

3 At the end of the examination:

(i) fasten the Answer Booklets used securely to the question paper,

(ii) tick the numbers of the Section **B** questions you have answered in the grid on the bottom right side corner.

Information for candidates

1 The number of marks is given in brackets [ ] at the end of each question or part question. Candidates are reminded that all quantitative answers should include appropriate units.

2 Tick the questions answered in Section **B** in the grid.

3 Candidates are advised to **show all their working** in a clear and orderly manner, as marks are awarded for correct working and for correct answers.

4 **Cell phones are not allowed in the examination room.**

Candidate's Use	*Examiner's Use*
Section A	
Section B	
9	
10	
11	
12	

This question paper consists of 15 printed pages

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Section A [50 marks]

Answer **all** the questions in the spaces provided on the question paper.

1 **Figure 1.1** shows an Engineer's callipers used to measure the diameter of a ball bearing.

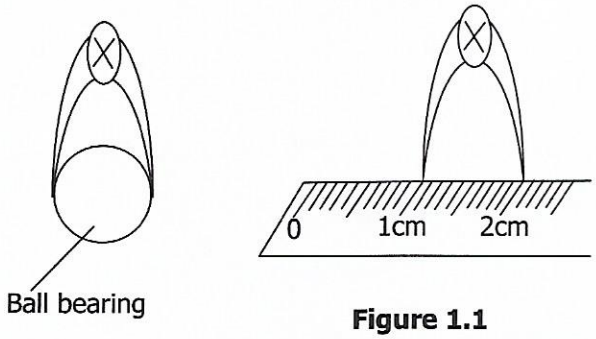

Figure 1.1

(a) What is the diameter of the ball bearing?

..... [1]

(b) Calculate the

(i) volume of the ball bearing,

Volume: ..... [2]

(ii) mass of the ball bearing if its density is 8.05g/cm^3.

Mass: ..... [1]

Total: 4 marks

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2 An unknown object from space travelling at high speed in a straight line enters the earth's atmosphere. **Figure 2.1** is the speed time graph for the object from the time it enters the earth's atmosphere until 50 seconds later.

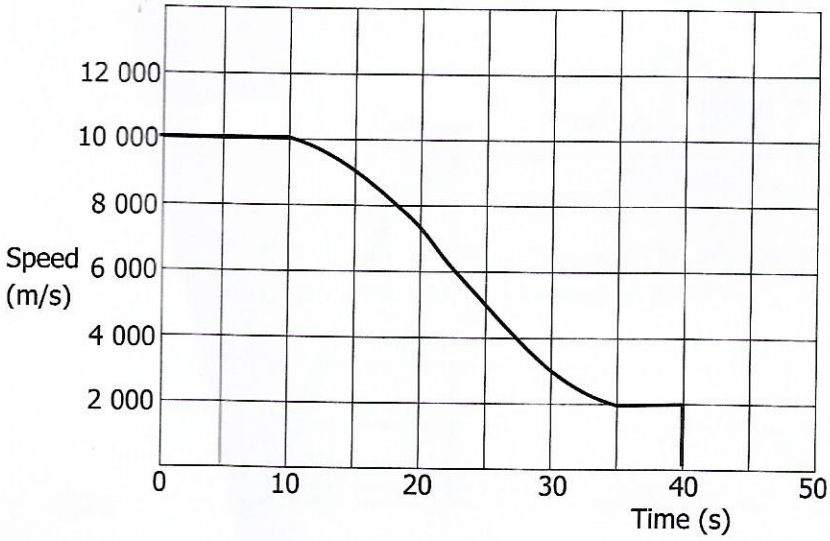

Figure 2.1

(a) On **figure 2.1**, indicate using the letter

(i) **C**, where the object has uniform deceleration, [1]

(ii) **D**, where the object has a non-uniform deceleration. [1]

(b) The mass of the object at time, t = 30 seconds is 5.5kg. Determine the

(i) acceleration of the object,

Acceleration:..... [2]

(ii) size of the resultant force on the object.

Resultant force: ..... [2]

Total: 6 marks

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3 **Figure 3.1** shows a fork lift used to move a wooden box of toys of mass 500kg along a 10m horizontal floor. The mass is then lowered by sliding it down a smooth plane inclined at 30° to the horizontal and 8m long.

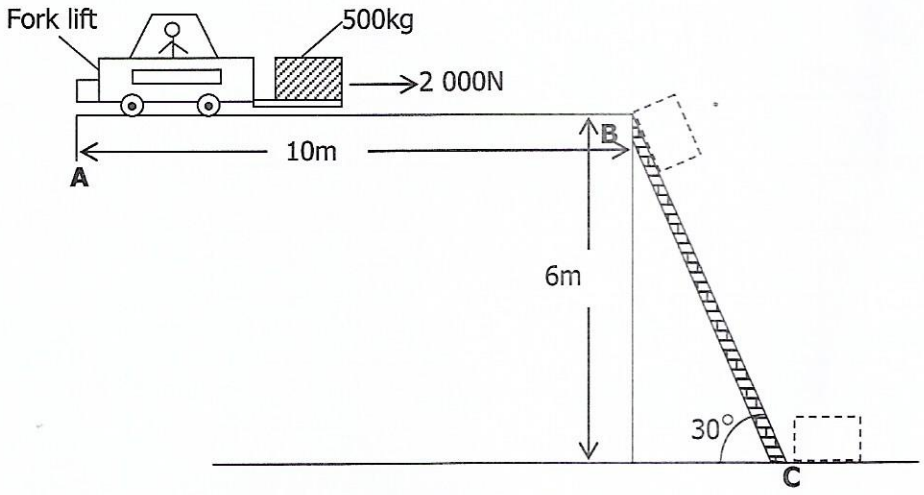

Figure 3.1

(a) Determine the

(i) work done by the fork lift in moving the box of toys through the distance of 10m,

Work done ..... [1]

(ii) loss in gravitational potential energy when the box reaches point **C**.

Loss in G.P.E ..... [2]

(b) State the energy changes that take place as the box moves from point **B** to point **C**.

.....

..... [1]

(c) **(i)** Calculate the efficiency of the smooth plane in moving the box from point **B** to point **C**.

Efficiency: ..... [2]

(ii) Explain how the efficiency would be affected if the smooth plane is made to be 10m and inclined at 25°.

.....

.....

..... [1]

Total: 7 marks

4 A cyclist observed that the pressure in the rear tyre of his bicycle was low and decided to inflate it using a bicycle pump as shown in **figure 4.1**.

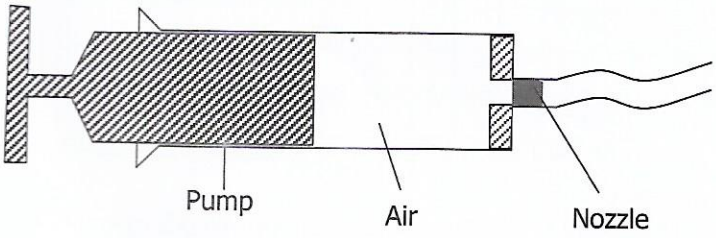

Figure 4.1

The air inside the pump is initially at a pressure of 80kPa. During a single stroke of the pump, the volume of air in the pump is reduced from $110cm^3$ to $10cm^3$.

(a) If the temperature of the air remains constant, calculate the pressure of the compressed air in the pump.

Pressure: ..... [2]

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(b) The compressed air in the pump exerts a force on the nozzle. The cross section area of the nozzle opening is $1.2 \times 10^{-5} m^2$.

Calculate the size of the force.

Force: ..... [2]

(c) The temperature of the air in the pump increases as its volume decreases.

Use the kinetic theory of matter to explain this observation.

.....

.....

.....

..... [2]

Total: 6 marks

5 A boiler at a steam electric power plant is filled with $450 m^3$ of water at $25^\circ C$.

The density of water is $1\,000 kg/m^3$ and its specific heat capacity is $4.2 J/(g^\circ C)$.

(a) Calculate the

(i) mass of the water in the boiler,

Mass ..... [2]

(ii) thermal energy (heat) needed to raise the temperature of the water to $100^\circ C$.

Thermal energy ..... [3]

(b) Give a reason why the thermal energy supplied to the water by the heating system when raising the temperature of the water to 100°C, differs from the value you calculated in **a (ii).**

.....

..... [1]

Total: 6 marks

6 A photographer takes a photograph of a flower using a camera. The image forms on the film. **Figure 6.1** shows an incomplete ray diagram showing light rays from the flower, through the camera lens to the film.

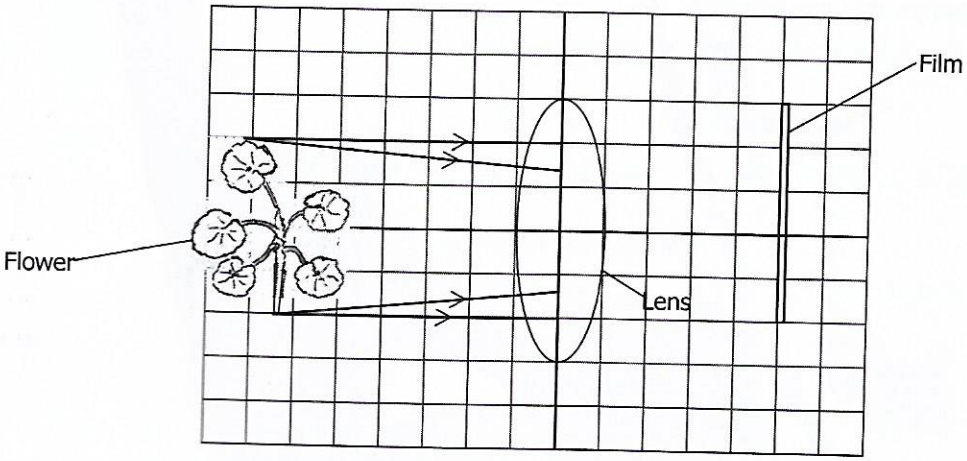

Figure 6.1

(a) **(i)** Complete the ray diagram to show how the image of the flower is formed on the film. [2]

(ii) State **one** characteristic of the image formed.

..... [1]

(b) In order to see an object in water, light rays should be reflected into the eyes.

(i) Determine the critical angle for a ray of light coming from water into air, given that the refractive index of water relative to air is 1.33.

Critical angle ..... [2]

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(ii) State the name of the effect that occurs when a ray of light hits the water-air boundary at an angle greater than the critical angle.

..... [1]

(iii) Give a practical application of this effect.

..... [1]

Total: 7 marks

7 **Figure 7.1** shows the apparatus used by a Laboratory Technician to measure the range of travel of beta particles in air. The source of beta particles used is strontium-90 with a half-life of 20 years.
Figure 7.2 shows a graph of the results obtained.

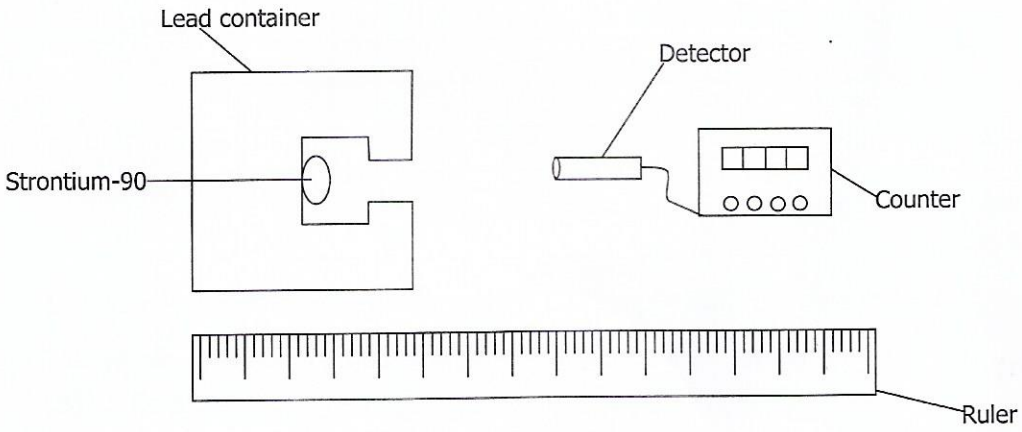

Figure 7.1

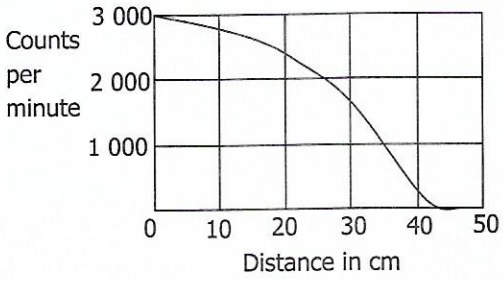

Figure 7.2

(a) Give a reason why the lead container is used.

.....

..... [1]

(b) If the count rate is 2 500 counts per minute, how long will it take to fall to 500 counts per minute?

..... [2]

(c) Using the graph in **figure 7.2**

(i) find the average distance a beta particle travels in air,

..... [1]

(ii) estimate the count rate when the source of beta particles is 30cm from the detector.

..... [1]

(d) Give **one** industrial use of beta particles.

..... [1]

Total: 6 marks

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8 **Figure 8.1** shows an ammeter, a rheostat and a 6.0Ω resistor connected in series with a 12.0V battery. A Cathode-Ray Oscilloscope (C.R.O) is connected in parallel with the 6.0Ω resistor as shown. The switch is **not** closed.

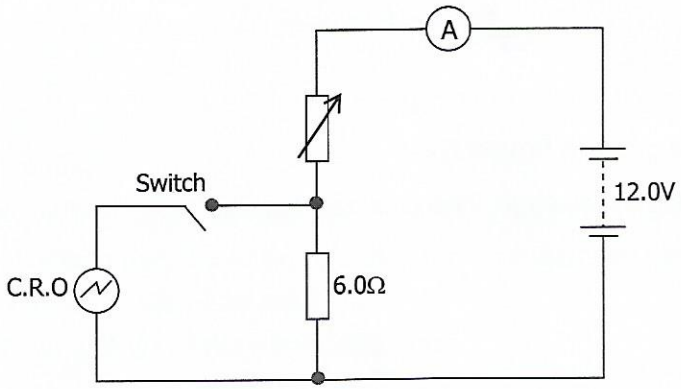

Figure 8.1

(a) The rheostat is adjusted so that it has a resistance of 12.0Ω.

Determine the

(i) current measured by the ammeter,

Current ..... [2]

(ii) potential difference (p.d) across the 6.0Ω resistor.

P.d ..... [1]

(b) The resistance of the rheostat is adjusted until the p.d across the 6.0Ω resistor is 8V.

What would be the effect of this adjustment on the

(i) current through the ammeter,

..... [1]

(ii) resistance of the rheostat.

..... [1]

(c) A horizontal line (trace) across the centre of the screen of the C.R.O is obtained when the p.d across the 6Ω resistor is still 8V.

The Y-gain is set at 2.0V/cm and the switch is closed. What is the effect of closing the switch on the horizontal line (trace) on the C.R.O screen?

.....

..... [1]

(d) When the C.R.O was connected to a microphone, the waveform shown in **figure 8.2** was seen on the screen.

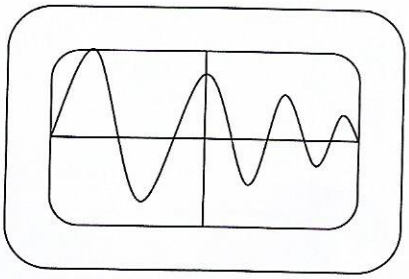

Figure 8.2

Explain what is happening to the

(i) volume of the sound,

.....

..... [1]

(ii) pitch of the sound.

.....

..... [1]

Total: 8 marks

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Section B [30 marks]

Answer any **three** questions.

9 **Figure 9.1** shows two cranes used to lift a tipper truck filled with sand. The total mass of the truck and sand is 20 tonnes and it is raised to a height of 5m. Each crane has a five pulley system and the tension, **T**, in the wire ropes are equal.

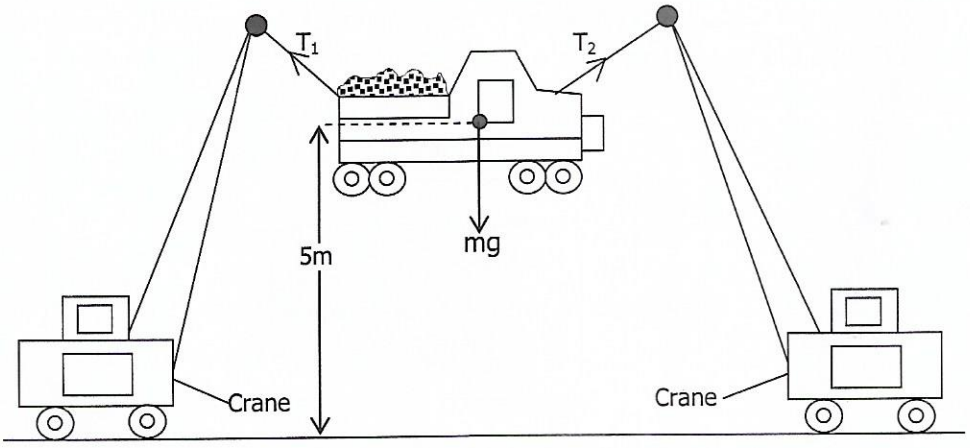

Figure 9.1

(a) Draw a vector diagram of force, using a suitable scale, and use it to determine the lifting force. [3]

(b) Calculate the

(i) energy possessed by the truck at a height of 5m. [2]

(ii) efficiency of the system. [2]

(c) It takes 2 minutes to lift the truck to a height of 5m. Determine the power output. [2]

(d) Outline the energy changes as the truck was being lifted up. [1]

Total: 10 marks

10 A student conducted an experiment to determine the specific heat capacity of a substance in a solid state. **Figure 10.1** shows the apparatus used.

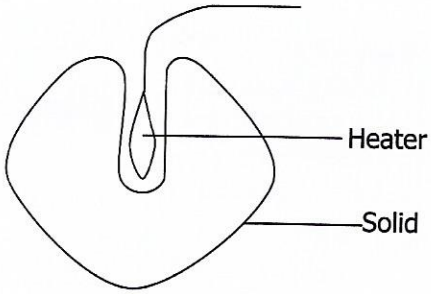

Figure 10.1

Table 10.1 shows the rating of the heater, mass of the solid and the melting point.

Table 10.1

Heater rating	1 000W, 240V
Mass of solid	600g
Melting point	150°C

(a) When the solid is heated for an hour, the temperature increases from 25°C to 120°c.

(i) State the meaning of specific heat capacity. [1]

(ii) Assuming that there were no energy loses, what is the specific heat capacity of the substance in **figure 10.1**. [2]

(b) Calculate the

(i) heat required to raise the temperature of the substance from 120°C to its melting point. [2]

(ii) specific latent heat of fusion if the heat required to melt the substance is equal to the one calculated in **(b) (i)**. [2]

(iii) current drawn by the heater. [2]

(c) Explain why the temperature remains the same during fusion. [1]

Total 10 marks

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11 A group of three learners were provided with five identical masses, an extensible spring and a 100cm ruler to investigate Hooke's Law. They arranged the apparatus as shown in **figure 11.1**. **Figure 11.2** shows the graph plotted from their results.

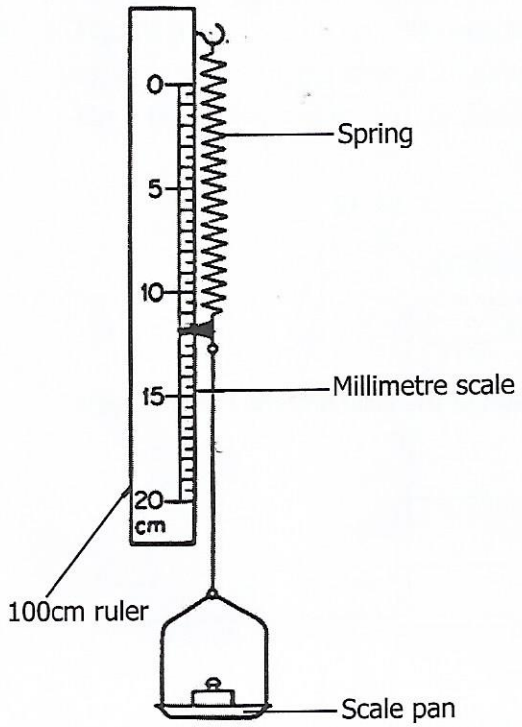

Figure 11.1

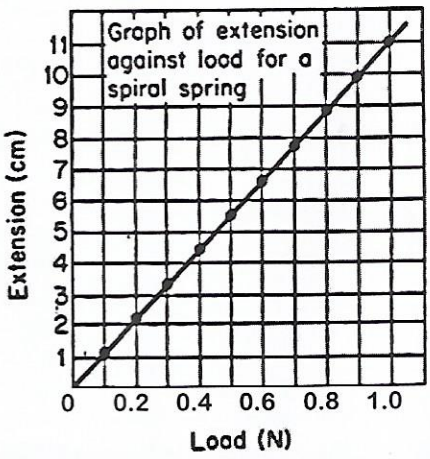

Figure 11.2

(a) **(i)** Explain why a spring balance measures weight and not mass. [1]

(ii) Show how a spring balance can be used to determine the mass of an object. [2]

(b) **(i)** Sketch a graph that could be used to determine mass using a spring balance. [2]

(ii) Calculate the spring constant. [1]

(iii) Give the importance of knowing the spring constant of a spring. [1]

(iv) Does the spring obey Hooke's Law? Explain your answer. [2]

(c) How will the spring change if the elastic limit is exceeded? [1]

Total: 10 marks

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12 **Figure 12.1** shows a latched fire alarm system in a milling factory. When the temperature of the surroundings exceed a certain upper limit, the alarm sounds.

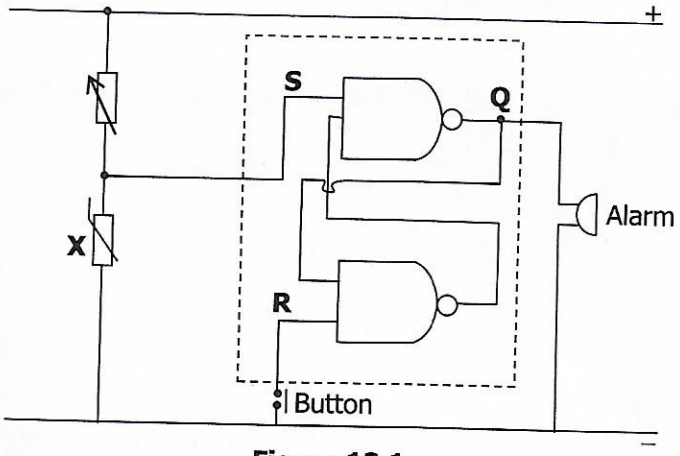

Figure 12.1

(a) Copy and complete the truth table for the circuit in **figure 12.1**. [2]

S	R	Q	Q
0	0		
0	1		
1	0		
1	1		

(b) **(i)** Name component **X**. [1]

(ii) State **one** property of component **X**. [1]

(c) A fire broke up in the milling factory and the alarm sounded. What are the corresponding values of **S** and **R** when the alarm is on? [1]

(d) The alarm continued to sound even when the fire was extinguished and the temperature lowered. State the action that should be taken in order to stop the alarm sounding. [1]

(e) The fire destroyed a lightning conductor on one of the tall buildings in the factory. Lightning is a dangerous effect of static electricity.

(i) Explain what causes the build-up of static electricity before lightning occurs. [1]

(ii) Describe the distribution of charge within a cloud before a lightning strike. [1]

(iii) The lightning conductor was a metal spike fixed to the top of the tall building and connected to the earth by a conducting wire.

Explain how lightning rods can protect a building. [2]

Total: 10 marks